## 3.14 HYDROLOGY AND WATER RESOURCES

This section addresses three types of hydrology and water resources—floodplains, surface water, and groundwater—that have the potential to be affected by the proposed alternatives. In addition, water quality issues are briefly addressed in relation to surface and groundwater resources. This section describes the existing hydrologic resources within the five regions and generally identifies the potential for impacts from each alternative and high-speed train (HST) alignments and station options on those resources. The analysis identifies the number and general extent of areas of hydrologic resources that potentially would be affected by the various alternatives for purposes of comparison.

### 3.14.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Several federal and state laws regulate and are designed to protect hydrologic resources, floodplains, and water quality. Below is a list of these statutes. (See Appendix 3.14-A for brief descriptions of these authorities.)

Federal Laws and Regulations

Clean Water Act (33 U.S.C. § 1251 *et seq.*): The purpose of the federal Clean Water Act (CWA) is to provide guidance for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters through prevention and elimination of pollution. The CWA applies to discharges of pollutants into waters of the U.S. The following CWA sections are most relevant to this analysis.

Section 10 of the Rivers and Harbors Act (33 U.S.C. 401 *et seq.*): Section 10 of the Rivers and Harbors Act, administered by the U.S. Army Corps of Engineers (USACE), requires permits in navigable waters of the U.S. for all structures such as riprap and activities such as dredging. Navigable waters are defined as those subject to the ebb and flow of the tide and susceptible to use in their natural condition or by reasonable improvements as means of interstate transport or foreign commerce. USACE grants or denies permits based on the effects of navigation. Most activities covered under this act are also covered under Section 404 of the CWA.

Executive Order 11988—Floodplain Management (U.S. DOT Order 5650.2; 23 C.F.R. 650, Subpart A): Executive Order (EO) 11988 directs all federal agencies to seek to avoid to the extent practicable and feasible all short-term and long-term adverse impacts associated with floodplain modification and to avoid direct and indirect support of development within 100-year floodplains whenever there is a reasonable alternative available.

Projects that encroach upon 100-year floodplains must be supported with additional specific information. The U.S. Department of Transportation Order 5650.2, titled "Floodplain Management and Protection," prescribes "policies and procedures for ensuring that proper consideration is given to the avoidance and mitigation of adverse floodplain impacts in agency actions, planning programs and budget requests." The order does not apply to areas with Zone C (areas of minimal flooding as shown on Federal Emergency Management Agency [FEMA] Flood Insurance Rate Maps [FIRM]). Environmental review documents should indicate potential risks and impacts from proposed transportation facilities.

Flood Disaster Protection Act (42 U.S.C. 4001–4128; DOT Order 5650.2, 23 C.F.R. 650 Subpart A; and 23 C.F.R. 771): The purpose of the Flood Disaster Protection Act is to identify flood-prone areas and provide insurance. The act requires purchase of insurance for buildings in special flood-hazard areas. The act is applicable to any federally assisted acquisition or construction project in an area identified as having special flood hazards. Projects should avoid construction in, or develop a design to be consistent with, FEMA-identified flood-hazard areas.

State Laws and Regulations

California Department of Fish and Game Code (§ 1601–1603 [Streambed Alteration]): Under Sections 1601-1603 of the Fish and Game Code, agencies are required to notify the California Department of Fish and Game (CDFG) prior to implementing any project that would divert, obstruct, or change the natural flow or bed, channel, or bank of any river, stream, or lake.

Porter-Cologne Water Quality Act (Water Code § 13000 *et seq.*): The Porter-Cologne Act is the basic water quality control law for California, and it provides for the State Water Resources Control Board (SWRCB) to implement the CWA for California.

Cobey-Alquist Flood Plain Management Act (Water Code § 8400 *et seq.*): The California Reclamation Board provides policy direction and coordination for the flood control efforts of state and local agencies along the Sacramento and San Joaquin Rivers and their tributaries in cooperation with USACE. It cooperates with various federal, state, and local government agencies in establishing, planning, constructing, operating, and maintaining flood-control works. The California Reclamation Board also exercises regulatory authority to maintain the integrity of the existing flood-control system and designated floodways by issuing permits for encroachments.

## B. METHOD FOR EVALUATION OF IMPACTS

Impact Evaluation

Potential impacts on hydrologic resources, floodplains, and water quality were evaluated using a combination of both qualitative and quantitative assessment methods. The existing conditions as described for the No Project Alternative provide the primary basis of comparison. Appendix 3.14-B provides a discussion of the impact ratings and summarizes the potential impacts.

Qualitative Assessment

A qualitative assessment was used to compare the alternatives when discussing issues such as runoff rates, sedimentation, or other items that would ultimately require a more detailed analytic approach (i.e., at the project level if the decision is made to proceed with the proposed HST system) than appropriate for a program-level analysis. For these items, the differences in impacts between the Modal and HST Alternatives are explained in general, qualitative terms.

Quantitative Assessment

For the quantitative assessment, readily available information on wetland areas, stream locations, existing water quality problem areas, flood zones, and general soil information was used to estimate the magnitude of the potential areas of impacts for the alternatives. The following steps were followed to estimate the potential areas of impact for floodplains and water quality from the No Project, Modal, and HST Alternatives.

- Acreage of floodplains defined as Special Flood Hazard Areas, as defined by FEMA on Flood Insurance Rate Maps, in the study area was identified and estimated to evaluate the area of floodplain potentially impacted by the alternatives.
- Acreage of surface waters (lakes) and the linear feet of surface waters (rivers and streams) in the study area was estimated, using U.S. Geologic Survey (USGS) 1:24,000 scale digital line graphs of blueline streams, including ephemeral streams. The linear feet of surface water was calculated based on the flow-path length of rivers and streams in the study area

to evaluate areas potentially affected by the alternatives. Lake surface areas represent the impoundment at maximum capacity.

- Waters with impaired water quality, i.e., waters identified on the Section 303(d) CWA list distributed by SWRCB, in the study area were identified.
- Acreage of areas of potential soil erosion in the study area was estimated to evaluate areas potentially affected by the alternatives. The calculations included those areas with a combination of erosive soils and steep slopes, evaluated as the product of *kfact* and *slopeh* (listed in the State Soil Geographic-STATSGO GIS database). Those conditions where *kfact* x *slopeh* is greater than 3.0 are potentially susceptible to erosion. *Kfact* designates the soil erodibility factor (including rock fragments) and *slopeh* indicates the soil slope.

The quantities of each type of hydrologic resource that could fall in the study area of either the Modal Alternative or the HST Alternative were estimated for each of the regions based on these steps.

## 3.14.2 Affected Environment

A. STUDY AREA DEFINED

The study area for hydrology and water quality is defined as 1) the area within 100 ft (30 m) of the centerline of the proposed HST Alternative alignments and within 100 ft (30 m) of the direct footprint of proposed new station facilities; and 2) the area within 100 ft (30 m) of the Modal Alternative direct corridor footprint and direct footprint of facilities, including corridors and facilities that would undergo upgrades/expansions.

<u>Topography and Climate</u>
The topography of the hydrology study area ranges from flat coastal and valley areas to mountain ranges, as discussed in Section 3.13, Geology and Soils. On average, about 75% of California's annual precipitation falls between November and March; 50% occurs between December and February. Northern California is much wetter than southern California, with more than 70% of California's average annual precipitation and runoff occurring in the northern part of the state (California Department of Water Resources 2003).

B. GENERAL DISCUSSION OF HYDROLOGY AND WATER RESOURCES

<u>Floodplains</u>
Floodplains are land next to a river that becomes covered by water when the river overflows its banks. FEMA designates and maps floodplains. In support of the National Flood Insurance Program (NFIP), FEMA has undertaken flood hazard identification and mapping to produce Flood Hazard Boundary Maps, Flood Insurance Rate Maps, and Flood Boundary and Floodway Maps. The zone of interest for the analysis of hydrologic resources in this program-level evaluation is defined as a special flood hazard area (SFHA) or Zone A, which is the flood insurance rate zone that corresponds to the 100-year flood hazard area in the hydrologic resource study area. Figures 3.14-1 and 3.14-2 provide maps showing SFHAs in the general vicinity of the hydrologic resources study area.

Floodplains are important because they provide floodwater storage and attenuate the risk of downstream flooding, typically provide important habitat for native species (discussed in Section 3.15, *Biological Resources and Wetlands*), improve water quality by allowing filtration of sediments and other contaminants, and may provide locations for groundwater recharge.

Floodplains encompass floodways, which are the primary areas that convey flood flows. Floodways are typically channels of a stream, including any adjacent areas. NFIP has introduced the concept of floodways and floodplains to assist local communities in floodplain management. The floodway is the channel of a stream, including any adjacent floodplain areas that must be generally kept free of encroachment so that the 100-year flood can be carried without substantial increases to flood heights. The area between the floodway and the 100-year floodplain boundary is referred to as the floodway fringe. Any approved encroachment may take place within the floodway fringe. According to guidelines established by FEMA, increase in flood height in the floodway due to any encroachment in the floodway fringe areas may not exceed 12 in (30.48 cm), provided that hazardous velocities are not produced in the water body. Constructing levees, rail and road embankments, buildings, etc., that encroach on floodplains may reduce the flood-carrying capacity and increase flood elevations.

<u>Surface Waters</u>
For this analysis, surface waters include improved flood control or drainage channels, intermittent river and stream channels, permanent river and stream channels, ponds, lakes, reservoirs, coastal estuaries and lagoons, and sloughs. In addition, other human-made water features include aqueducts and salt evaporating ponds.

The California State Water Project is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping facilities. Its main purpose is to store water and distribute it to urban and agricultural water suppliers in northern California, the San Francisco Bay Area, the San Joaquin Valley, the central coast, and southern California. The State Water Project includes about 660 mi) (1,062 km) of open canals and pipelines.

The federal Central Valley Project (CVP) is a long-term project for the storage and delivery of waters of the Sacramento River basin in the north for use in the San Francisco Bay Area, the farmlands of the San Joaquin Valley, and other metropolitan areas in the south.

The CVP's primary purposes include flood control; improvement of navigation on Central Valley rivers; development of hydroelectric power, irrigation, and municipal and industrial water supply; protection of the Sacramento-San Joaquin River Delta from seawater encroachment; and protection and enhancement of fish and wildlife.

Streams and lakes are important for fish and wildlife, for water supply, and because they convey floodwaters and may contribute to or attenuate the risk of downstream flooding. They provide important habitat for native species and may support wetland and riparian habitats (discussed in Section 3.15, *Biological Resources and Wetlands*), provide direct pathways connecting to downstream ecological or human resources, and provide locations for groundwater recharge.

Lagoons and estuaries are sheltered, semi-enclosed, brackish bodies of water along shorelines where fresh and salt waters interface through tidal flows and currents. Pollution from storm water runoff, industrial discharges, and boats can damage these resources, especially if their tidal flow is limited, naturally or otherwise. Of the areas being studied in this document, only the Los Angeles to San Diego via Orange County (LOSSAN) region includes lagoons and estuaries. The amount, frequency, duration, and quality of freshwater flows affect the salinity levels, which in turn dictate the types of biological resources associated with a particular water body. Figures 3.14-3 and 3.14-4 provide maps showing surface waters in the general vicinity of the hydrologic resources study area. (See Section 3.15, *Biological Resources and Wetlands*, for a discussion of wetlands).

Groundwater

Groundwater is found in subsurface water-bearing formations. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers. Groundwater basins, which do not necessarily coincide with surface drainage basins, are defined by surface features and/or geological features such as faults, impermeable layers, and natural or artificial divides in the water table surface. The elevation of groundwater varies with the amount of withdrawal and the amount of recharge to the groundwater basin. Groundwater basins may be recharged naturally as precipitation infiltrates and/or artificially with imported or reclaimed water. Shallow groundwater is subject to potential impacts from dewatering during construction.

Figures 3.14-5 and 3.14-6 provide maps showing groundwater basins within the general vicinity of the hydrologic resources study area.

## C. WATER QUALITY

Surrounding land uses affect surface water and groundwater quality. Both point-source[1] and nonpoint-source[2] discharges contribute contaminants to surface waters. Pollutant sources in urban areas include parking lots and streets, rooftops, exposed earth at construction sites, and landscaped areas. Pollutant sources in rural/agricultural areas primarily include agricultural fields and operations.

The impacts of nonpoint-source pollutants on aquatic systems are many and varied. Polluted runoff waters can result in impacts on aquatic ecosystems, public use, and human health from ground and surface water contamination, damage to and destruction of wildlife habitat, decline in fisheries, and loss of recreational opportunities. Small soil particles washed into streams can smother spawning grounds and marsh habitat. Suspended small soil particulates can restrict light penetration into water and limit photosynthesis of aquatic biota. Metals and petroleum hydrocarbons washed off roadways and parking lots, and fertilizers, pesticides, and herbicides from landscaped areas, may cause toxic responses (acute or long-term) in aquatic life, or may harm water supply sources such as reservoirs or aquifers.

Erosion

Potential impacts on water quality may result from construction activity (e.g., grading, which removes vegetation, exposing soil to wind and water erosion). A potential erosive condition occurs in areas with a combination of erosive soil types and steep slopes. Erosion can result in sedimentation that ultimately flows into surface waters. Contaminants in runoff waters may include sediment, hydrocarbons (e.g., fuels, solvents, etc.), metals, pesticides, bacteria, nutrients, and trash. Figures 3.14-7 and 3.14-8 provide maps showing areas with soils susceptible to erosion in the general vicinity of the hydrologic resources study area.

Impaired Waters

Some water bodies have been given special status under the CWA. Section 303(d) of the CWA requires each state to identify waters that will not achieve water quality standards after application of effluent limits, and to develop plans for water quality improvement. For each water body and pollutant for which water quality is considered impaired, the state must develop load-based (as opposed to concentration-based) limits called total maximum daily loads (TMDLs). TMDL is the maximum amount of pollution (both point and non-point sources) that a water body

[1] *Point source* is a stationary location or fixed facility, such as the end of a pipe, from which pollutants are discharged. (U.S. Environmental Protection Agency 2002.)

[2] *Nonpoint source* pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water (U.S. Environmental Protection Agency 2002).

can assimilate without violating state water quality standards. Priorities for development of TMDLs are set by the state, based on the severity of the pollution and the beneficial uses of the waters. The U.S. Environmental Protection Agency's (EPA's) TMDL program provides a process for determining pollution budgets for the nation's most impaired waters. Pollutant loading limits are set and implemented by SWRCB under the Porter-Cologne Act. The program includes development of water quality standards, issuance of permits to control discharges, and enforcement action against violators.

## D. HYDROLOGY AND WATER RESOURCES BY REGION

Bay Area to Merced

This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley.

Floodplains: As delineated by FEMA, 100-year floodplains have been mapped along the streams bordering San Francisco Bay, along Coyote and Suisun Creeks, and along the Guadalupe, Pajaro, Sacramento, San Joaquin, and Merced Rivers and their tributaries.

Surface Waters: Major streams and surface waters in the study area in this region include San Francisco Bay and the Guadalupe, Pajaro, San Joaquin, and Merced Rivers. The study area also includes Lake Merritt Tidal Channel, Quarry Lakes, extensive tidal flats and salt evaporating ponds in the South Bay, and the estuaries of Coyote Creek and Guadalupe River. The Hetch Hetchy and California Aqueducts, Don Castro and San Luis Reservoirs, San Filipe Lake, and O'Neill Forebay are also located in the study area in this region. Many of the streams and creeks in this region are considered impaired waters.

Groundwater: Groundwater is present in two distinct areas in the Bay Area to Merced region. Relatively uniform, unconfined aquifers and associated water tables are expected in the two valleys at either end of the proposed alignments, the Central Valley to the east and the San Francisco Bay/Santa Clara Valley to the west. Groundwater in these basins is routinely pumped for domestic and agricultural purposes and is subject to long-term fluctuations in water levels due to overdraft and recharge conditions. Groundwater is generally considered shallow in recharge/discharge areas near the San Joaquin River and its tributaries in the Central Valley, near San Francisco Bay, and in the area of the Sacramento-San Joaquin River Delta. Occurrence of groundwater in the Diablo Range would likely be influenced by fracture patterns and rock type.

Sacramento to Bakersfield

This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield.

Floodplains: In the study area in the Sacramento to Bakersfield region, 100-year floodplains exist along most of the minor creeks and streams in rural areas. In urban areas and along most of the reaches of the major rivers, the 100-year floodplains are contained within the riverbanks. Levees and floodwalls have been constructed in urban areas, restricting the river flows. Upstream dams also control many of the rivers. Land in certain low-lying rural areas is subject to frequent shallow flooding.

Surface Waters: more than two dozen rivers flow in this region, including the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, Fresno, San Joaquin, Kings, Kaweah, Tule, and Kern Rivers. Additionally, the study area along the west side of the Central Valley includes a portion of the California Aqueduct, the San Luis Canal, and the Sacramento-San Joaquin Delta. Groundwater and surface water are pumped to and from these and many other surface canals and drains that deliver irrigation water to and from agricultural fields throughout the region. The canals are packed earth or concrete-lined and generally lack the meanders, vegetation, biota, and other features of natural streams.

Groundwater: Groundwater levels in the Central Valley fluctuate with seasonal rainfall, withdrawal, and recharge. The large demand for groundwater has caused subsidence in some areas. Depth to groundwater in the study area in this region ranges from a few inches to more that 100 ft (30 m). Most of the groundwater in the region is present in unconfined or semi-confined aquifers as a part of the Sacramento Valley and San Joaquin Valley groundwater basins. Most areas have, at best, moderate recharge capability because infiltration is limited by clay or hardpan layers in the surface soils or subsurface materials.

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles.

Floodplains: In the Bakersfield to Los Angeles region, 100-year floodplains exist along most of the minor creeks and streams in the rural areas south of Bakersfield and north of Palmdale. Land in low-lying rural areas is subject to frequent shallow flooding. While not within the 100-year floodplain, canyon areas through the Tehachapi Mountain range may be subject to flooding from storms.

Surface Waters: The major rivers, streams, and lakes in the region are the California and Los Angeles Aqueducts, Pyramid Lake, and the Santa Clara and Los Angeles Rivers. Smaller creeks and streams exist south of Bakersfield and north of the urban area of Los Angeles County. Seasonal washes and canyons are found within the study area.

Groundwater: Groundwater in this region includes three regional groundwater basins consisting of the Basin and Range, California Coastal Basin, and Central Valley aquifer systems. The depth of these aquifers varies by location. Relatively uniform, unconfined aquifers and associated water tables are expected in the two valleys at either end of the proposed alignments, the San Fernando Valley to the south and the San Joaquin Valley to the north. Groundwater in these basins is routinely pumped for domestic and agricultural purposes and is subject to long-term fluctuation in water levels due to overdraft and recharge conditions. Groundwater in the mountainous regions between the points represented by the San Gabriel and Tehachapi Mountains is highly variable, affected by fracture permeability in rock units and local alluvial valleys that are relatively restricted in their extent.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors.

Floodplains: In this region, the FEMA-designated 100-year floodplains are mapped around significant drainage channels in the Ontario area or riparian areas between March Air Reserve Base (ARB) and Temecula.

Surface Waters: The major rivers in the region include the Los Angeles, San Gabriel, Santa Ana, San Jacinto, San Luis Rey, San Dieguito, and San Diego Rivers, and the Rio Hondo Channel. Other major water resources include the California, Riverside Canal, San Diego, and Val Verde Tunnel–Colorado River Aqueducts. Seasonal washes and canyons are common. Lake Hodges and Lee Lake are also in the study area. Of these resources, the Los Angeles, San Gabriel, and Santa Ana Rivers are considered impaired waters.

Groundwater: Groundwater generally occurs in two distinct areas in the region. Relatively uniform, unconfined aquifers and associated water tables are expected in the Los Angeles basin, which includes all of downtown Los Angeles and extends east to just west of Ontario. Groundwater in the mountainous regions (the Peninsular Ranges province), from the Los Angeles basin to the tip of Baja California, is highly variable, controlled by fracture permeability in rock units and local alluvial valleys that are relatively restricted in their extent.

Los Angeles to San Diego via Orange County

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the coastal areas of southern California between Los Angeles and San Diego, generally following the existing LOSSAN rail corridor.

Floodplains: As delineated by FEMA, 100-year floodplains in the region are associated with significant drainage channels or riparian areas just south of Anaheim, or are within coastal areas just south of Camp Pendleton to San Diego.

Surface Waters: The rivers and channels in the region include Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, San Dieguito, and San Diego Rivers and Rio Hondo Channel. Other water resources include Buena Vista, Agua Hedionda, Batiquitos, San Elijo, and San Dieguito Lagoons, and San Diego and Mission Bays.

Water bodies with impaired water quality in the region include the Los Angeles, San Gabriel, Santa Ana, Santa Margarita, and San Luis Rey Rivers, and the Rio Hondo Channel. The rivers are considered impaired because they exceed standards for algae, ammonia, metals, chloroform count, pesticides, nutrients, toxicity, trash, and/or sedimentation. The lagoons and the San Diego and Mission Bays are also considered impaired because of declining water quality, increased freshwater input, accumulated sediment, diminished biological productivity, and water circulation constraints.

Groundwater: The California Coastal Basin Aquifer is the primary aquifer identified in the region. Groundwater depth within the region varies from a few feet to more than 100 ft (30 m). Perched aquifers with a shallow water surface occur throughout Los Angeles and Orange Counties. Shallow groundwater is also likely adjacent to or in the vicinity of streams, rivers, lagoons, and bays.

Two varieties of groundwater are found along the proposed coastal routes. The first is perched water, which infiltrates and percolates through the sandy terraces, then becomes perched on or within less porous bedrock units. This contributes to the instability of the Del Mar and San Clemente coastal bluffs. Efforts to control the instability have included improvements to the storm drain system, surface drainage, and sub-drains. The second variety of groundwater is subsurface water that saturates surface and formational materials in the vicinity of alluvial or estuarine environments, such as the mouths of the major drainage areas and lagoons.

### 3.14.3 Environmental Consequences

Potential impacts on hydrology and water resources which may result from the alternatives or the proposed HST system alignment and station options include potential encroachment on or location in a floodplain, potential impacts on water quality, potential increased/decreased runoff and stormwater discharge due to changes in the amount of paved surfaces, potentially increased or decreased contribution of nonpoint-source contamination from automobiles, and potential impacts on groundwater from dewatering or reduction of groundwater recharge.

### A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The existing conditions assume that the effects of the current built environment on hydrologic resources and water quality would continue. The No Project Alternative assumes that in addition to existing conditions, planned and programmed transportation improvements would be constructed and operational by 2020. The potential impacts of the No Project Alternative on hydrologic resources and water quality are assumed to be limited because typical design and construction practices would need to meet permit conditions. However, some impacts on hydrologic resources would likely result from the implementation of the projects under the No Project Alternative, such as increased runoff from added lanes of paved surface and new columns for expanded bridges over rivers and streams. However, attempting to estimate these potential changes would be speculative. It is assumed that project-level environmental documents and permits would be prepared by project proponents for future projects that would affect hydrologic resources and water quality. These project-level documents would identify and analyze, and avoid, minimize, or mitigate potential impacts on hydrology and water quality to the extent feasible.

It is assumed that existing conditions would not change substantially, and thus the existing conditions serve as the baseline to which the impacts from the Modal Alternative and HST Alternative would be added.

### B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HST ALTERNATIVES

It is assumed that any improvements associated with the Modal and HST Alternatives would be in addition to those included in the No Project Alternative. Based on available information for the study area, there is a substantial difference in the estimated acreage and linear feet of hydrologic resources that would potentially be crossed by the Modal Alternative compared to the HST Alternative (as shown in Table 3.14-1). These estimated areas of potential impacts on hydrologic resources and water quality would not provide a primary means of differentiating among the potential impacts of alternatives, because neither alternative presents significant potential impacts that cannot be substantially avoided, minimized, or mitigated through conventional design and construction processes, and compliance with permits and best management practices (BMPs) required for project permits. For instance, it is expected that streams and rivers would largely be spanned by bridges (culverts also can be used) to minimize potential impacts on the flow and water quality of these hydrologic resources. Further, potential impacts on water quality from surface runoff or erosion during project construction would be identified during the project-specific analysis and the design phase, and standard BMPs would be used to minimize potential impacts. The primary difference between alternatives would be the cost to bridge over streams and rivers, tunnel under wetland areas, or construct elevated guideways to minimize potential impacts on surface flow.

Areas with identified sensitive habitat, such as the Don Edwards San Francisco Bay National Wildlife Refuge (National Wildlife Refuge), the San Francisco Bay and salt marshes, and the Diablo/Pacheco Pass area near Gilroy, are discussed in Section 3.15, *Biological Resources and Wetlands*. These areas have streams and wetlands that provide potential habitat to special-status species. Avoiding or minimizing impacts on hydrologic resources and riparian corridors would be an important factor in selecting a corridor as a preferred alternative that is expected to include a least environmentally damaging alternative.

Table 3.14-1 summarizes the potential area of impacts on the various hydrologic resources examined as part of this evaluation. In most cases, the area and extent of the potential direct impacts would be a function of an alternative's alignment, or alignment option in the case of the HST Alternative.

**Table 3.14-1**
**Summary of Potential Hydrologic Resource and Water Quality Impacts for Alternatives**

| Region | Floodplains in Acres (Hectares) | Streams in Linear Feet (Meters) | Lakes[a] in Acres (Hectares) | Erosion in Acres (Hectares) | Groundwater in Acres (Hectares) |
|---|---|---|---|---|---|
| **Modal Alternative** | | | | | |
| Bay Area to Merced | 2,872 (1,162) | 2,039,748 (621,715) | 663 (268) | 2,954 (1,195) | 14,128 (5717) |
| Sacramento to Bakersfield | 2,235 (905) | 161,599 (49,255) | 17 (7) | [b] | 16,642 (6,735) |
| Bakersfield to Los Angeles | 125 (51) | 46,362 (14,131) | 32 (13) | 3,016 (1,221) | 1,276 (516) |
| Los Angeles to San Diego via Inland Empire | 238 (96) | 118,210 (36,030) | 14 (6) | 615 (249) | [b] |
| Los Angeles to San Diego via Orange County (HST corridor equivalent) | 115 (47) | 1,410 (430) | 0 | 95 (38) | 0 |
| Los Angeles to San Diego via Orange County (conventional rail corridor equivalent) | 95 (38) | 6,915 (2,108) | 5 (2) | 1,335 (540) | Low |
| Modal System-wide Totals[d] | 5,540 (2,242) | 2,367,329 (721,562) | 726 (594) | 6,680 (2,703) | 32,046 (12,969) |
| **High-Speed Train Alternative** | | | | | |
| Bay Area to Merced | 305–781 (123–316) | 270,057–453,248 (82,313–138,150) | 80–226 (32–91) | 1,698–2,797 (687–1,132) | 2,621–3,995 (1,061–1,617) |
| Sacramento to Bakersfield | 994–2,150 (402–870) | 97,657–147,406 (29,766–44,929) | 0–2 (0–1) | [b] | 7,265–11,018 (2,940–4,459) |
| Bakersfield to Los Angeles | 322–424 (130–172) | 29,568–70,880 (9,012–21,604) | 0–18 (0–7) | 2,974–3,661 (1,204–1,482) | 1,665–2,100 (674–850) |
| Los Angeles to San Diego via Inland Empire | 224–423 (91–171) | 53,030–84,120 (16,164–25,640) | 9–10 (4–4) | 490–838 (198–339) | [b] |
| Los Angeles to San Diego via Orange County (HST corridor) | 20–95 (8–38) | 1,950–4,565 (594–1,391) | 0 | 210–465 (85–188) | 0 |
| Los Angeles to San Diego via Orange County (conventional rail corridor)[d] | 295 (119) (Lower-level improvements) | 11,210 (3,417) | 12 (5) | [b] | [b] |
| | 225 (91) (Higher-level Improvements | 12,105 (3,690) | 11 (4) | [b] | [b] |

| Region | Floodplains in Acres (Hectares) | Streams in Linear Feet (Meters) | Lakes[a] in Acres (Hectares) | Erosion in Acres (Hectares) | Groundwater in Acres (Hectares) |
|---|---|---|---|---|---|
| HST System-wide Totals | 1,865–3,873 (755–1,567) | 452,262–760,219 (137,850–231,715) | 89–256 (36–104) | 5,372–7,761 (2,174–3,141) | 11,551–17,113 (4,675–6,925) |

a Includes lagoons in the LOSSAN region.
b Numeric data not available.
c The number of potential conflicts associated with the HST Alternative is provided as a range of potential conflicts. For each region, the HST Alternative generally includes various proposed alignment options within each segment of the region. These routes serve only to provide a reasonable range of impacts for comparative purposes and do not represent any selection of a particular option as preferred.
d Analyzed by distinguishing low- and high-level improvement scenarios for this corridor.

For all resource topics except erosion, the maximum extent of potential impact area for the HST Alternative alignment options is expected to be less than the extent of potential impact area for the Modal Alternative. For example, the number of acres of floodplains that would potentially be impacted by the Modal Alternative would be 1.4 times the maximum number potentially impacted by the HST Alternative, and the number of linear feet of streams that would potentially be impacted by the Modal Alternative would be more than three times the maximum number potentially impacted by the HST Alternative. The only resource topic in Table 3.14-1 for which that would not apply is erosion; where figures are available, the number of acres of highly erodible soils found in the study area of the Modal Alternative would be within the range of those for the HST Alternative. However, there are proposed HST Alternative alignment options for which the number of potential erosion impacts would be less than what would be expected for the Modal Alternative. In general, the numbers presented in Table 3.14-1 suggest that most of the HST Alternative alignment options would potentially affect fewer sensitive hydrologic resources than the Modal Alternative statewide.

Implementation of either the Modal or HST Alternative would result in the potential for indirect impacts that are independent of location, but rather based on design characteristics. Because of design characteristics, the Modal and HST Alternatives would add different amounts of impervious surface area. The HST Alternative would consist of permeable track-fill rather than impervious pavement expansion. The quantity of impervious surface attributable to proposed HST Alternative alignments would therefore be substantially less than the estimated 4,640 total ac (1,878 ha) of pavement expansion expected under the Modal Alternative. Thus, the HST Alternative would potentially result in less runoff and would have better infiltration potential. Smaller runoff volumes under the HST Alternative would be less likely to contribute to downstream flow levels and would not increase the extent and frequency of flooding in flood-prone areas that could occur with implementation of the Modal Alternative. The HST Alternative would result in a smaller amount of added impervious surface than the Modal Alternative. As a result, the potential impacts of the HST Alternative on groundwater recharge would likely be less than the potential impacts of the Modal Alternative on groundwater recharge rates in areas where recharge is likely, such as near rivers.

Another design characteristic that differentiates the Modal and HST Alternatives involves the width of structures that would be added or improved. Whereas multiple 12-ft (4-m) lane additions for highways and new runways would be included throughout much of the study area of the Modal Alternative, the alignment width included for HST Alternative improvements would typically be 50 ft (15 m) total, and the total width would not be used completely for structure. The smaller width would accommodate fewer columns to support HST Alternative structures, which would result in less encroachment in floodplains and surface water resources. The HST Alternative would include tunnels and elevated structures designed to avoid or limit impacts that would further reduce potential impacts on hydrologic resources compared to the Modal Alternative. The HST Alternative would also allow for greater flexibility than the Modal Alternative at the design stage in addressing site-specific conditions. For example, greater flexibility in designing bridges over lagoons in the LOSSAN region would allow greater latitude to avoid potential impacts under the HST Alternative than the design of highway expansion under the Modal Alternative. The HST Alternative could be designed to span lagoons with minimal fill materials. Such options would not be available for highway expansion under the Modal Alternative because engineering options would be constrained by existing conditions and engineered fill.

### 3.14.4 Comparison of Alternatives by Region

The key findings of the analysis are summarized below by region and alignment options. For a complete summary of all potentially affected hydrologic resources by region, see Appendix 3.14-B.

A. BAY AREA TO MERCED

Modal Alternative

In general, the Modal Alternative would present a high potential impact on floodplains and streams in this region because it would include improvements to I-80 and I-580. Essentially, there are more corridor miles for the highway expansion under the Modal Alternative than HST corridor miles, which would result in twice the extent of potential floodplain and surface water encroachments. The Modal Alternative would cross several floodplains and streams in this region, including Suisun Creek and Sacramento River, as a result of the proposed expansion of I-80 through the Sacramento River Delta area. Potential impacts would also result from expansions of US-101 and SR-152 through the Santa Clara Valley near Gilroy, and in the Central Valley south of Merced, where there are extensive floodplains and streams, including Coyote Creek and the Guadalupe, Pajaro, San Joaquin, and Merced Rivers. Expansion of SR-152 by two lanes would potentially affect San Luis Rey Reservoir and O'Neill Forebay.

The Modal Alternative would cross substantial groundwater resources, mostly as a result of the I-80 expansion from San Francisco to Sacramento. As there is no tunneling proposed for the Modal Alternative, these groundwater resources would be potentially impacted by short-term dewatering during construction in areas where shallow groundwater occurs, and by reduced recharge in areas paved with impervious surface over the long term.

High-Speed Train Alternative

The HST Alternative would potentially affect floodplains associated with Coyote Creek; the Guadalupe, Pajaro, San Joaquin, and Merced Rivers; and the salt ponds and sloughs within and adjacent to the National Wildlife Refuge. Potential effects to these resources might include increases in flood height in the case of the floodplains from earthen berms or linear barriers to surface flow, or encroachment within the physical structure of the salt ponds. Streams potentially affected include those associated with floodplains. Shallow groundwater at potential tunneling sites in the mountain regions (Diablo Range and Pacheco Pass) could be affected by dewatering that in turn could affect groundwater levels.

High-Speed Train Alignment Option Comparison

The San Francisco to San Jose HST alignment option would operate within the Caltrain right-of-way and would cross fewer streams than the Oakland options (Mulford Line and I-880). However, stream crossing would not be a distinguishing factor for two reasons. First, impacts would be reduced and potentially avoided to the extent feasible through the use of elevated structures over surface waters associated with the Coyote Creek river system and the many sloughs through the salt ponds in and adjacent to the National Wildlife Refuge. Second, the rivers encroached upon by the Caltrain right-of-way are channeled and highly developed. The

Hayward alignment/I-880 option would have fewer potential impacts on the waters of the refuge than the Hayward/Niles/Mulford alignment. The northern tunnel Diablo Range HST alignment option from San Jose to Merced would avoid substantially more floodplains than the southern Pacheco Pass option through Gilroy, crossing an average of 159 ac (64 ha) compared to 548 ac (222 ha) of floodplains for the southern Pacheco Pass option. The Pacheco Pass route would potentially contribute to flood risk in the Pajaro River watershed, which is presently prone to flooding. A potential increase in flood risk would be addressed by engineering design measures (e.g., elevated guideways to minimize obstructions in floodway) that would be a part of the next phase of project development, should the project advance to project-specific evaluation.

The Diablo Range direct alignment options would potentially result in the following.

- Substantially avoid both lakes and rivers, compared to the southern option through Gilroy, crossing an average of 286,056 linear ft (87,190 m) of rivers and 2 ac (0.8 ha) of lakes for the three northern options, compared to an average of 447,187 linear ft (136.303 m) of streams and 76 ac (31 ha) of lakes for the three southern options.
- Cross many of the mountain streams that feed Coyote Creek and potentially contribute to the siltation of the Anderson and Coyote Reservoirs.
- Avoid more floodplains than the southern Pacheco Pass option through Gilroy, crossing an average of 159 ac (64 ha) compared to 548 ac (222 ha) for the southern Pacheco Pass option.
- Substantially avoid groundwater resources, crossing an average of 1,505 ac (609 ha) for the three northern options as opposed to an average of 2,716 ac (1,099 ha) for the three southern Pacheco Pass options.
- Avoid some potential groundwater impacts through the use of tunnels with the proposed northern alignment options in the Diablo Range between San Jose and Merced. Most of the groundwater resources in the study area are found in the Santa Clara and the Central Valleys, which would be avoided by routing the alignment through the Diablo Range.

The southern Pacheco alignment options would potentially result in the following.

- Cross mountain streams (including Carnadero, Llagas, Pacheco, and Tequisquita Creeks) tributary to the Pajaro River, which empties into Monterey Bay.
- Contribute to elevated sedimentation levels in the creeks, which could affect Monterey Bay, because of construction across the above-mentioned streams.
- East of the Diablo Mountain Range, the northern route would cross the Crow and Orestimba Creeks and the San Joaquin and Merced Rivers.
- Cross Cottonwood Creek, a tributary of the San Luis Reservoir, and Romero Creek, as well as several low-lying wetlands, ditches, and sloughs that feed the San Joaquin River. The northern route would cross Crow and Orestimba Creeks, and the San Joaquin and Merced Rivers.
- Cross more floodplains than the Diablo Range direct options that run through more of the Santa Clara and Central Valleys, both of which contain more groundwater resources than the mountains.
- Potentially contribute to flood risk in the Pajaro River watershed, which is presently prone to flooding.

## B. SACRAMENTO TO BAKERSFIELD

Modal Alternative

The Modal Alternative in this region would generally involve widening SR-99 and I-5 and expanding the Sacramento Airport with six new gates. I-5 crosses a substantial amount of the Sacramento River Delta between Stockton and Sacramento, and the Sacramento airport is located near the Sacramento River, as well. As a result, the Modal Alternative would potentially encroach on more acres of floodplains region-wide than either of the HST alignment options, thus it would present greater potential for impacts on floodplains.

Direct potential impacts on canals are not expected to be substantial. Potential impacts on lakes would be expected to be similar for the various alignment options, since few Modal or HST Alternative alignments would encroach on lakes. Expansion of the I-5 corridor would result in potential erosion in the Sacramento to Stockton, Merced to Fresno, and Tulare to Bakersfield segments in an area where it would run through the mountains at the edge of the Coastal Range foothills. The Modal Alternative would result in minimal potential impacts on groundwater in this region (the mapped data does not show substantial groundwater in the study areas for modal improvements).

High-Speed Train Alternative

South of Stockton, both HST Alternative alignment options would potentially encroach on more floodplains than the Modal Alternative alignment. There is a network of canal systems in the Sacramento to Stockton corridor in the areas surrounding Modesto, Fresno, and Hanford/Visalia. The HST Alternative would cross many of these canals. Project-specific erosion potential would not pose a problem in this region, since the slope grade through most of the Central Valley would be minimal.

As with the Modal Alternative, potential direct impacts on groundwater resources from the HST alternative would be limited to infrequent shallow groundwater occurrence where dewatering may be necessary during construction of at- and above-grade structures (e.g., support columns) and for tunneling portals. The HST Alternative, which would have permeable-surface construction, would produce smaller runoff volumes and lower potential surface contamination levels than would be expected under the Modal Alternative, which would add lanes of pavement on highways.

High-Speed Train Alignment Option Comparison

In general, the maps show that the western HST alignment (Union Pacific Railroad [UPRR] north of Fresno, Burlington Northern Santa Fe [BNSF] south of Fresno) would potentially encroach on fewer acres of floodplains than the eastern HST Alternative alignment (BNSF north of Fresno, UPRR south of Fresno). Each of the Sacramento station options in the Sacramento to Stockton corridor occurs within the 100-year FEMA floodplain. The downtown station option has less than an acre of its footprint within this flood hazard zone and thus has a low potential for flood hazard. In contrast, the two station options at Power Inn Road along UPPR and BNSF would encroach into more floodplain area and are considered to have a medium potential for flood impacts. The inclusion of a high-speed loop around Merced would extend the HST Alternative through a large floodplain, increasing the amount of floodplains potentially affected.

In general, the BNSF and Central California Traction (CCT) alignments between Sacramento and just north of Merced would cross fewer linear feet of streams, rivers, and canals combined than the UPRR alignment. Most of the stream crossings under the UPRR alignment, however, are due to canal crossings, not river crossings, which are generally smaller, and could be realigned if necessary. The BNSF alignment south of Hanford would cross more linear feet of rivers and canals than the UPRR alignment. The many canals found in this segment would make canal realignment a more costly undertaking than in other segments.

Potential impacts on lakes would be similar for the alignment options because each of the proposed alignments intersect less than 1 ac (.40 ha) of lakes. Potential groundwater impacts are not distinguishable among the alignment options because the groundwater level is deeper, and no tunneling or trenching would be included in the HST options in the region.

C. BAKERSFIELD TO LOS ANGELES

Modal Alternative

The Modal Alternative alignment would potentially affect approximately 30,000 linear ft (9,144 m) of streams in the region. Potential impacts on lakes, though considerably less of an issue region-wide, would vary by alignment within the Bakersfield to Sylmar corridor. The Modal Alternative (expansion of I-5) would potentially encroach on 31.6 ac (13 ha) of lakes, mostly consisting of Pyramid Lake and some of Castaic Lake. Though potential erosion would be of considerable concern within the Tehachapi corridor in the Bakersfield to Los Angeles Region, the difference in the number of acres of highly erodible soil potentially affected by the alternatives and their respective alignment options would be small, providing little distinction between the Modal and HST Alternatives based on potential for erosion.

High-Speed Train Alternative

Similar to the Modal Alternative, two of the HST alignment options would potentially affect about 30,000 linear ft (9,144 m) of streams. The SR-58 option would potentially affect about 60,000 linear ft (18,288 m) of streams. In addition, the HST Alternative would potentially encroach on Castaic Lake and Pyramid Lake.

Groundwater resources would not be an issue in the Sylmar to Burbank and Burbank to Los Angeles Union Station (LAUS) corridors because the alignment structures would be either at or above grade. The HST alignment options would affect floodplains mainly in the valleys between Bakersfield and the base of the Tehachapi Mountains.

High-Speed Train Alignment Option Comparison

The I-5 HST alignment option that includes the Union Avenue and Wheeler Ridge connections with the I-5 Tehachapi corridor would have a higher probability of affecting floodplains in the Bakersfield to Los Angeles region than either the SR-58/Soledad Canyon HST alignment option or the Modal Alternative. This is primarily because the former alignment would potentially encroach upon large areas of floodplain between Bakersfield and the bottom of the ascent over the Tehachapi's at the Grapevine. The I-5 Tehachapi corridor option would potentially affect approximately 30,000 linear ft (9,144 m) of streams, which is the same as the Modal Alternative, compared to the SR-58/Soledad Canyon HST alignment option, which would potentially affect twice that amount. The potential impact in the SR-58/Soledad Canyon HST option is due to the relatively small seasonal streams in Soledad Canyon between Palmdale and Sylmar.

The SR-58 HST alignment potentially would not encroach on any lakes, whereas both of the I-5 Tehachapi corridor alignment would potentially encroach on 18 ac (7 ha) of lakes, including Castaic Lake in the Castaic Valley of the Tehachapi, and Upper Van Norman Lake south of the San Fernando Pass.

Absent field verification and more detailed data collection, it is not possible at this program level of analysis to determine specifically which HST Alternative alignment option, with its respective tunneling in the Tehachapi Mountains, would potentially affect more groundwater resources.

## D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

### Modal Alternative

In general, floodplains are not as extensive in the Los Angeles to San Diego region as they are in the Central Valley. The potential impact of Modal Alternative improvements in this region on floodplains would be minimal, because floodplains are highly developed and flood control is part of the existing infrastructure design, which means improvements made with the Modal Alternative would be less likely to contribute to flooding potential. The Modal Alternative would cross minor floodplains in the Temescal and Temecula Valleys.

In the Mira Mesa to San Diego segment, the Modal Alternative would raise the potential for increased runoff and sediments because it would cross approximately 10 times more linear feet of streams than the HST Alternative, or 63,830 linear ft (19,455 m) of streams compared to an average of 6,983 linear ft (2,128 m) for the three HST Alternative alignment options. The Modal Alternative would potentially cross substantially more water-quality-impaired waters than the HST Alternative.

Groundwater resources would not be substantially affected by highway and airport expansion in this region. There are no segments where tunneling or trenching would be required, and shallow groundwater is not prevalent along the Modal Alternative alignment.

### High-Speed Train Alternative

Similar to the Modal Alternative, the potential impact of HST Alternative alignment options in this region on floodplains would be minimal, because floodplains in this area are highly developed and flood control is part of the existing infrastructure design which the HST alignments would parallel as much as possible. Potential erosion would be a concern where the alignment options would extend to or along the coast along highly erodable slopes.

The HST Alternative would not substantially affect groundwater resources in this region. None of the segments would include tunneling or trenching, and shallow groundwater is not prevalent along the proposed HST Alternative alignment. With respect to the tunneling that is proposed in the Merriam Mountains between Temecula and Escondido, and in Escondido, little groundwater is present, and these areas would likely not require substantial dewatering during construction.

### High-Speed Train Alignment Option Comparison

Though impacts on floodplains are expected to be minimal in this region, the UPRR Riverside/UPRR Colton Line alignment option without connection to San Bernardino would potentially encroach on fewer acres of floodplains than the UPRR Colton Line to San Bernardino option, or the UPRR Colton alignment option with and without San Bernardino in the Los Angeles to March ARB alignment. The South El Monte station would have potential floodplain impacts. The existing floodplain dataset would not provide a basis to distinguish between the two Escondido-traversing alignments. The two alignment options extending to the coast would present a higher potential to affect floodplains than the other HST alignment option or the Modal Alternative. The UPRR Colton Line HST alignment would potentially encroach on considerably fewer linear feet of streams than the UPRR Riverside alignment in the Los Angeles to March ARB segment. Many of these resources are already highly altered and mostly channeled, and would be little affected by the proposed HST system. The UPRR Riverside HST alignment options would potentially encroach on fewer water-quality-impaired waters than the UPRR Colton Line or the San Bernardino option or the Modal Alternative.

Three general station areas are proposed within 100 ft (30 m) of streams, which could increase the potential for contaminated runoff from parking areas entering the streams. The South El Monte station would be within 100 ft (30 m) of the San Gabriel River in South El Monte, the

Colton station would be within 100 ft (30 m) of the Santa Ana River, and the University of California, Riverside station would be within 100 ft (30 m) of Gage Canal. These rivers are mostly channelized. Unstable slopes would result in potential erosion with the two HST alignment options that extend to and run along the coast in San Diego to the downtown station stop.

Potential groundwater impacts would be similar for the proposed HST options.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Modal Alternative
The Modal Alternative would not be expected to have a substantial impact on floodplains in the region. The floodplains crossed by I-5 are highly developed, and flood control is part of the existing infrastructure. No impacts on streams or lakes have been identified in this region. Streams in the LAUS to Irvine corridor would be minimally affected because streams in this area are highly developed, and flood controls are part of the existing infrastructure design.

Widening of bridge structures, added columns, and/or increasing the embankment footprints for I-5 improvements through lagoons in San Diego County may potentially impede tidal flushing and potentially adversely affect the hydrologic conditions of the lagoons. Bridge widening would also increase the potential for impacts from stormwater runoff. Construction through these lagoons could potentially induce erosion, and potentially result in a temporary increase in the sediment load in these impaired waters. Construction of Modal Alternative improvements would potentially affect areas of intermittent shallow groundwater from dewatering during construction.

High-Speed Train Alternative
The HST Alternative would not be expected to have a substantial impact on streams or lakes in this region. Streams in the LAUS to Orange County corridor would be minimally affected because streams in this area are highly developed, and flood controls are part of the existing infrastructure. Potential impacts on streams would be minimized through southern Orange and San Diego Counties.

The HST system could be designed to minimize the number of existing piers/columns and fill in the lagoons, thereby limiting potential impacts on water circulation and water quality. As with the Modal Alternative improvements, construction through the lagoons would potentially result in a temporary increase in the sediment load in these impaired waters.

Some of the tunneled and trenched sections of the HST Alternative alignment options pass through areas of the California Coastal Basin Aquifer. Tunneled and trenched sections in the LAUS to Orange County and Orange County to Oceanside segments would potentially affect groundwater during construction. Areas of shallow groundwater may also be affected by at-grade HST construction. These areas would require dewatering and erosion control measures during construction.

High-Speed Train Alignment Option Comparison
The UPRR alignment option in the LAUS to Orange County corridor would cross fewer acres of floodplains than the LOSSAN alignment, but the UPRR route would involve more trenching than the LOSSAN option. Alignment options south of Irvine include proposed tunneling and trenching in many of the areas where they would otherwise potentially encroach on floodplains, which would substantially reduce their potential impacts on floodplains.

Proposed improvements for the inland options include tunnels and trenches, which would limit the potential impacts resulting from crossing streams in southern Orange and San Diego Counties. In San Juan Capistrano, the proposed tunnel along I-5 would potentially affect fewer surface water resources than an at-grade and trenched alignment on the east side of Trabuco Creek. The latter would pose potential temporary sedimentation impacts during construction from erosion and runoff.

In the Dana Point/San Clemente and Del Mar areas, the implementation of the proposed HST system (non-electric conventional rail in this segment) along the existing coastal route could result in potential erosion of coastal bluffs. This erosion would potentially increase sedimentation in local surface waters, including sensitive lagoons in the Del Mar area. Of the two alignment options that would avoid the coastal bluffs through the Dana Point/San Clemente area, the short tunnel would have slightly more potential for impacts on surface waters, namely San Juan Creek, than the longer, two-segment tunnel, because the short tunnel option would involve more at-grade and trenched portions. There are two alignment options that avoid the coastal bluffs through Del Mar. The first would involve a tunnel under I-5 that would surface at the southern edge of San Dieguito Lagoon and cross the lagoon with a new bridge structure. This option would potentially reduce hydrologic impacts on Los Peñasquitos Lagoon. However, potential impacts may occur with the construction of a bridge across the floodplain and river of San Dieguito Lagoon. The second option involves a tunnel under Camino Del Mar. This option would improve the amount of tidal circulation in Los Peñasquitos Lagoon through improved bridge design and would limit new impacts on San Dieguito Lagoon by staying within the footprint of the existing corridor.

### 3.14.5 Mitigation Strategies

Proposed general mitigation strategies would be fairly similar for all regions. These strategies are described as general policies that could be adopted and developed in detail at the project-specific level of environmental analysis. First, measures designed to avoid or limit impacts would be considered. If avoidance measures were not feasible, then mitigation measures directed at reconstruction, restoration, or replacement of the resource, in close coordination with state and federal resource agencies, would be considered as part of subsequent project planning, environmental review, and design. Potential mitigation strategies are listed below by resource.

A. FLOODPLAINS

Mitigation for potential impacts on floodplains would include consideration of the following strategies.

- As part of the future project-level analysis, floodplain hydrology/hydraulics would be analyzed to evaluate the impacts of specific designs on water surface elevations and flood conveyance for low-frequency floods, and to evaluate potential flooding risk. Where feasible, avoid or minimize construction of facilities within floodplains. Where feasible, restore the floodplain, if impacted by construction, so it can again operate as before. Where no practicable alternative to avoid construction in the floodplain exists, minimize the footprint of facilities within the floodplain, e.g., by use of aerial structures or tunnels.
- As part of the future project-level analysis, all opportunities for facility redesign or modification to minimize flooding risk and potential harm to or within the floodplain would be assessed.

B. SURFACE WATERS, RUNOFF, AND EROSION

Mitigation strategies for potential impacts on surface waters would include consideration of the following.

- As part of the future project-level analysis, conduct studies and evaluate potential alteration in coastal hydrology/hydraulics in tidal lagoons, bays, and marshes from specific construction methods or facility designs. Construction methods or facility designs to minimize potential impacts would be considered and used to the extent feasible.
- Permit requirements as part of project-level review would include Storm Water Pollution Prevention Plans (SWPPPs) and National Pollutant Discharge Elimination System (NPDES) permits. The SWPPP would include BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater management, and channel dewatering for all stream and lake crossings. Regional NPDES permit requirements would be followed and BMPs, as required for new developments, would be implemented. These may include measures to provide permeable surfaces where feasible and to retain and treat stormwater onsite using catch basins and treatment (filtering) wetlands. Other measures to manage the overall amount and quality of stormwater runoff to regional systems would be detailed as part of SWPPP.
- Apply for and obtain appropriate permits under Sections 404 and 401 of CWA and comply with mitigation measures required in the permits. Other mitigation measures may include habitat restoration, reconstruction onsite, or habitat replacement offsite to compensate for loss of native habitats and wetlands. The ultimate goal of the mitigation would be to ensure minimal impact on surface water quality.

C. GROUNDWATER

Mitigation to reduce potential impacts from construction and operation of project components on groundwater discharge or recharge would include consideration of the following strategies.

- As part of the future project-level analysis, minimize development of facilities in areas that may have substantial groundwater discharge or affect recharge.
- Apply for and obtain waste discharge requirements, where needed (e.g., for de-watering), as part of project-level review.
- As part of the future project-level analysis, develop facility designs that are elevated, or at a minimum are permeable, and would not affect recharge potential where construction is required in areas of potentially substantial groundwater discharge or recharge.
- Apply for and obtain a SWPPP under NPDES permit requirements for grading, and describe BMPs that would control release of contaminants near areas of surface water or groundwater recharge (include constraining fueling and other sensitive activities to alternative locations, providing drip pans under some equipment, and providing daily checks of vehicle condition).
- Include consideration of use and retention of native materials with high infiltration potential at the ground surface in areas that are critical to infiltration for groundwater recharge.

### 3.14.6 Subsequent Analysis

Subsequent analysis to further identify potential impacts on water quality and hydrologic resources would be required as project development, environmental review, and facility design are pursued, if a decision is made to go forward with the proposed HST system. This subsequent analysis may include the following.

- Further analysis and assessment of potential facility impacts on floodplains, specifically on flood elevations, as specific locations and facility designs are developed to determine if the proposed facility is in the base floodplain (that area which has a 1% or greater chance of flooding in any given year). The analysis would identify potential encroachment on study-area floodplains as defined in

Executive Order 11998 for Floodplain Management (23 C.F.R. § 650[a]) and DOT Order 5650.2, or location of facilities in a 100-year floodplain without adequate mitigation measures.

- Further analysis (hydrologic modeling of flow rates) of potential construction and facility impacts on surface hydrology in coastal areas and tidal marshes and lagoons, and on other surface waters.
- Analysis of potential construction and facility impacts on surface hydrology in areas that are characterized as wetlands and that were not included in this analysis because field verification and wetland delineation was not part of this program-level evaluation. (See Section 3.15, *Biological Resources and Wetlands*, for discussion of wetlands.)
- Field surveys of potential surface water impacts to further analyze potential impacts on water quality and to seek required permits from the appropriate agencies.
- Identification of potentially substantial alteration in water-flow and drainage patterns, including increased storm water runoff, or increased groundwater discharge or reduction of groundwater recharge.
- Evaluation of potential impacts of the alternatives on groundwater recharge and infiltration systems.
- Identification and study of areas of shallow groundwater to determine possible dewatering impacts resulting from construction.
- Analysis of how the different alignment options would contribute to total additional impervious surface and the subsequent potential additional impacts on surface runoff. This analysis would also identify potential mitigation measures, including onsite retention facilities.
- Field geotechnical studies to evaluate the potential for erosion and associated risks.
- Field surveys of groundwater discharge or recharge conditions. Additional supplemental analysis of groundwater conditions with information from other geotechnical studies.